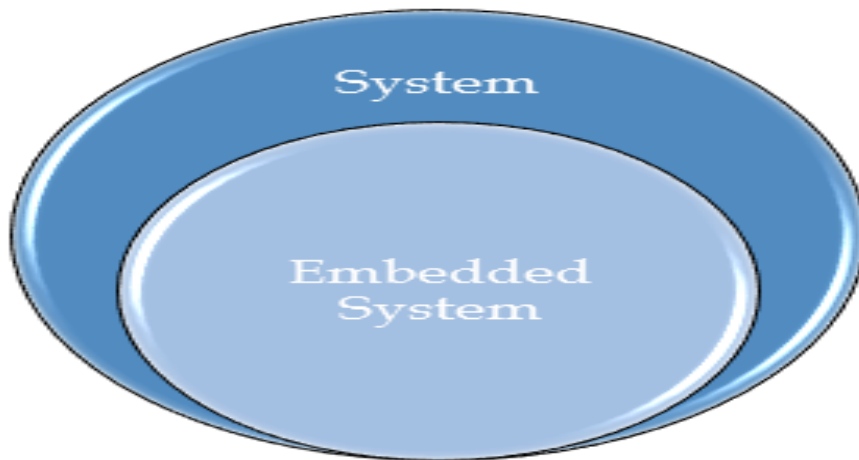


## 1)what is system?

- A system is a group of units that are joined together to work in a specific routine and perform some fixed operation.
- These units could be of any nature i.e. if you are working on an electronics system then these units will be electronic components.

Similarly, if you are working on some mechanical system then these units will be mechanical equipment or machinery etc

ex-watch



## 2)what is embedded sysytem?

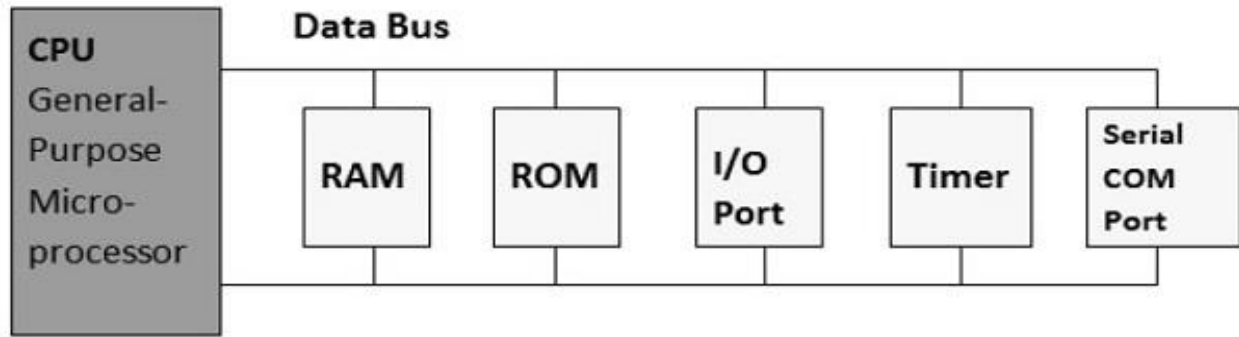
- **Embedded System** - As its name suggests, Embedded means something that is attached to another thing. **Embedded System** is a computer **system embedded into an device, appliance** or a unit that is used to create any automation device or to control any machines using Micro Controller.
- Any sort of device which includes a programmable computer but itself is not intended to be a general-purpose computer”
- It includes hardware as well as software and it is a part of a larger system and is expected to function without human intervention.
- An embedded system is expected to respond, monitor as well as control external environment using sensors and actuators.
- So, basically what we are talking about is embedding a computer into an appliance and, that computer is not expected to be used for general purpose computing. Since it is embedded into an appliance, it needs to interact with the external world, so it has got analog interfaces.

### 3) difference btw microprocessor and microcontroller?

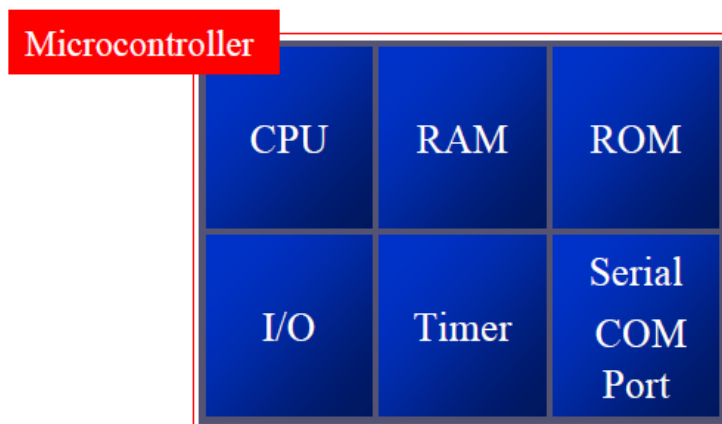
- **Microprocessor** is a general purpose device
- General-purpose microprocessors contains
- No RAM, No ROM, No I/O ports
- **Microcontroller**
- A microcontroller is a single-chip VLSI unit (also called **microcomputer**) which, although having limited computational capabilities, possesses enhanced input/output capability and a number of on-chip functional units.
- Microcontroller has CPU (microprocessor), RAM, ROM, I/O ports, Timer
- ADC and other peripherals

Microcontrollers are particularly used in embedded systems for real-time control applications with on-chip program memory and devices

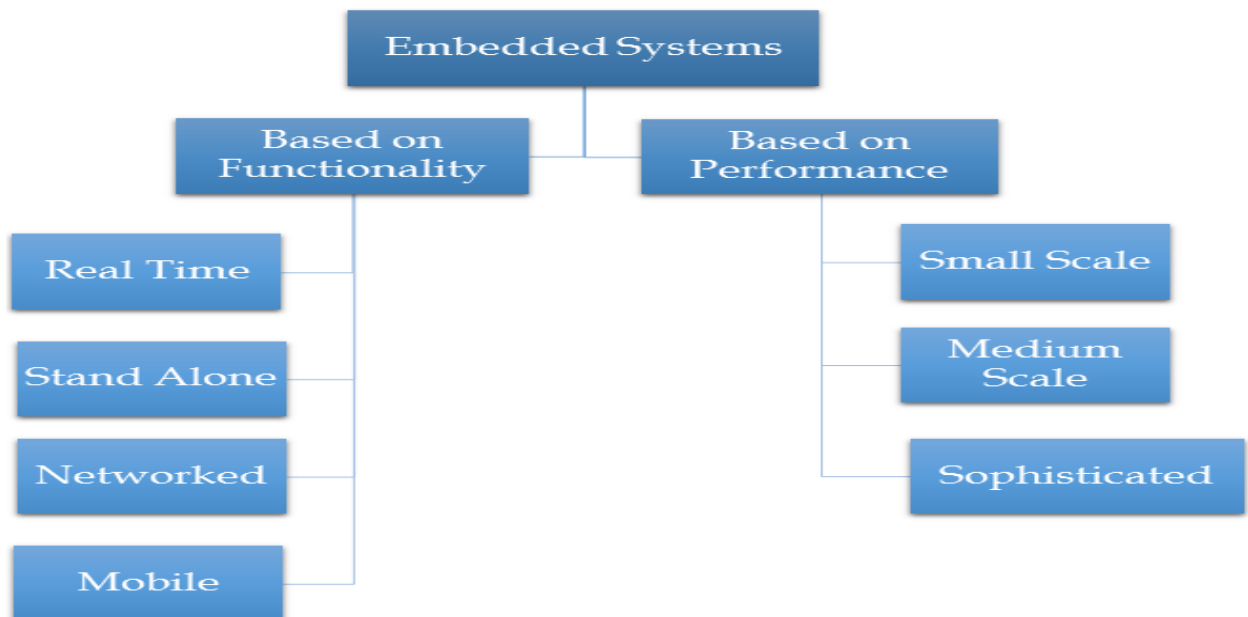
Microprocessor	Microcontroller
<p>Microprocessors are multitasking in nature. Can perform multiple tasks at a time. For example, on computer we can play music while writing text in text editor.</p> <p>A PC, in contrast with the embedded system, can be used for any number of applications</p> <p>It has RAM memory and an operating system that loads a variety of applications into RAM and lets the CPU run them.</p> <p>A PC contains or is connected to various embedded products</p> <p>Each one peripheral has a microcontroller inside it that performs only one task</p>	<p>Single task oriented. For example, a washing machine is designed for washing clothes only.</p> <p>An embedded product uses a microprocessor (or microcontroller) to do one task and one task only There is only one application software that is typically burned into ROM</p>



A SIMPLE BLOCK DIAGRAM OF A MICROPROCESSOR



4)classification of embeded syystem?



Based on functions performed by embedded systems, it is divided into four types:

### **Real Time**

An embedded system that gives an output within a specified amount of time is called a real-time embedded system. That is, in addition to a proper output, it adheres to time constraints as well. They can be further classified into soft real-time embedded systems and hard real-time embedded systems.

### **Stand Alone**

As the name suggests, these are embedded systems that can work by themselves. In other words, they are self sufficient, and don't require a host system or computer to function. While they will require inputs and other devices for output, the processing and work is done only by themselves. Examples include videogame consoles, music players and microwave ovens.

### **Networked Embedded Systems**

- Embedded systems that are connected to a network and depend on it for their functioning are called networked embedded systems. They may or may not have smaller or less complex subsystems running to create the network. Examples include home security systems and heat sensor systems.
- These systems are connected with network that could be LAN, WAN or internet. The connection can be wireless or wired.

### **Mobile Embedded Systems**

- Embedded systems meant for mobile communications are called mobile embedded systems. They include mobile phones, tablet computers and the like, and are usually categorized by functions like internet, calling, in addition to more complex functions seen in today's smartphones. This is the class of embedded systems which is used in portable devices.
- The examples of devices are mobile phones, cameras, music players etc.

### **Performance based Embedded systems**

- Based on performance of microcontroller, they are divided into three types:

#### **Small Scale Embedded Systems**

- If the microcontroller used in embedded system is 8 bit or 16 bit then it is classified into small scale embedded system.
- Such systems have less complex hardware and software parts and can also be operated on batteries.
- Normally such embedded system uses Arduino boards or PIC Microcontrollers or 8051 Microcontrollers etc.

# SMALL SCALE EMBEDDED SYSTEM

- Single 8 bit or 16bit Microcontroller.
- Little hardware and software complexity.
- They May even be battery operated.
- Usually “C” is used for developing these system.
- The need to limit power dissipation when system is running continuously.

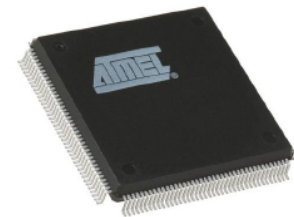


**Programming tools:**

**Editor, Assembler and Cross Assembler**

# MEDIUM SCALE EMBEDDED SYSTEM

- Single or few 16 or 32 bit microcontrollers or Digital Signal Processors (DSP) or Reduced Instructions Set Computers (RISC).
- Both hardware and software complexity.



**Programming tools:**

**RTOS, Source code Engineering Tool, Simulator, Debugger and Integrated Development Environment (IDE).**

# SOPHISTICATED EMBEDDED SYSTEM

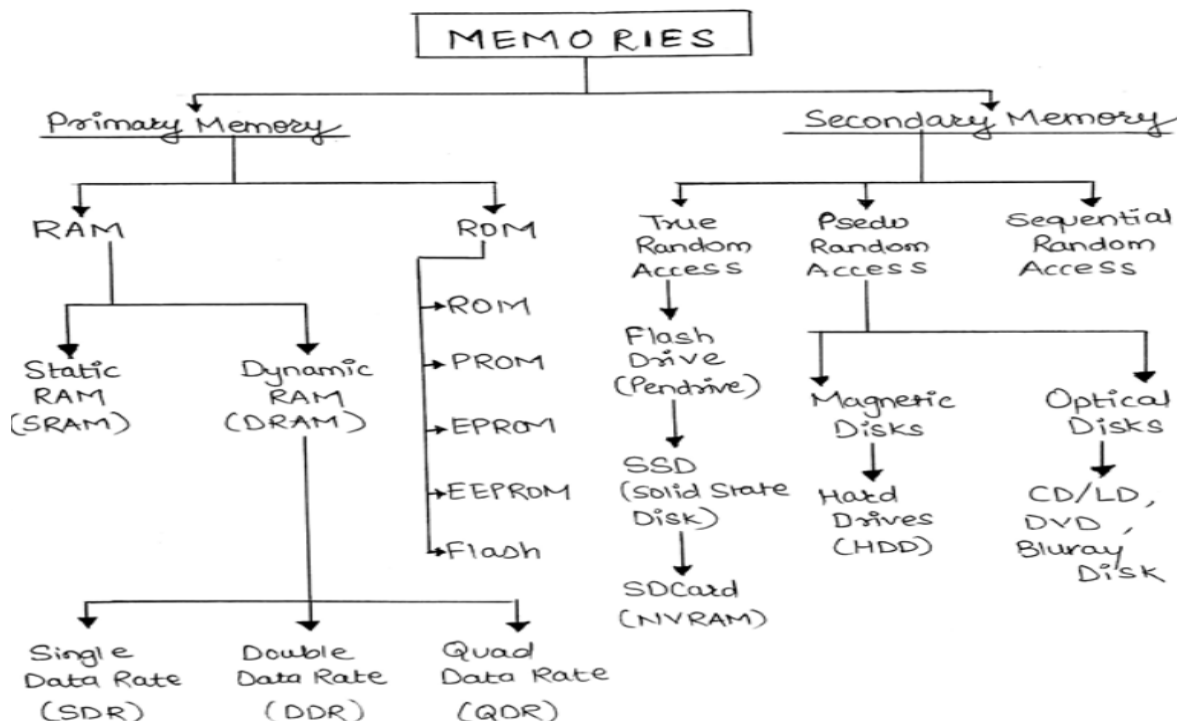
- Enormous hardware and software complexity
- Which may need scalable processor or configurable processor and programming logic arrays.
- Constrained by the processing speed available in their hardware units.



## Programming Tools:

For these systems may not be readily available at a reasonable cost or may not be available at all. A compiler or retargetable compiler might have to be developed for this.

Q5)memory and its type?



- Memory can be broadly classified into 2 types namely
  - Primary memory &
  - Secondary memory.
- The real difference between primary and secondary memories is **the speed/volatility tradeoffs**.
- Primary memory is directly addressed by the processor.

#### Types

- RAM
- ROM
- **RAM: (Random Access Memory)** Read or write memory. It stores temporary data and stack.
- Two most important types of RAM are
- **SRAM**
- **DRAM.**
- They are both volatile memories used as primary storage on embedded systems. But each has its place in microcontroller design. The main difference between them comes from their speed/cost tradeoffs.

#### types of ram

- **1. Static Random Access Memory (SRAM)**
- Data is stored in the form of voltage. It is made up of flip flops. It is realized using 6 transistors. 4 transistors are part of flip flop and two transistors are for control access.
- This is the faster of the two, **approximately 4 times faster** than the DRAM.
- Since it needs more transistors per bit of data, it is also **more expensive** compared to DRAMs.
- **2. Dynamic Random Access Memory (DRAM)**
- It stores data in the form of charge. It is made up of MOS transistors. The circuit has 1 MOSFET and a capacitor.
- The reason behind its name comes from the fact that the **data stored in this RAM needs to be refreshed every few milliseconds or else it will end up being erased**. Yes even if the power is being applied continuously the data still needs to be refreshed. This action is taken care of by a special device named **DRAM controllers**.
- The reason behind this dynamic behavior is because of the capacitor present in its design.

- Earlier the SRAM was called just RAMs but later after the introduction of DRAMs, the term “static” got introduced into its name in order to differentiate it from the DRAM technology!

	<b>SRAM</b>	<b>DRAM</b>
Construction Principle	It uses a cross-coupled flip flop configuration of transistors	It uses a capacitor transistor circuit to hold data
Cost	Relatively more expensive, it needs more transistors per bit of data it can store	Relatively less expensive, as fewer transistors per bit of storage are needed
Speed	4X more than DRAM	4X less speed
Volatility	As long as power is ON, it can store data since it uses no capacitors	Data needs to be continuously refreshed (usually in the order of 4 times a second) since the capacitors leak power.
Power consumption	Less	More
Addition components needed	None	DRAM controllers are needed to make it work like an SRAM. This controller offloads the data refreshing duties of a microprocessor and hence a DRAM coupled with a DRAM controller behaves more like an SRAM from the processor's perspective.
Application areas	Applications/scenarios that need very fast memory	Budget applications that do not need the speed of SRAMs

rom(read only memory)

- It stores application programs from where processor fetches instruction code. It stores codes for system booting and RTOS.
- It retains content even after system is turned off. It is a non-volatile storage memory.



<b>RAM</b>	<b>ROM</b>
1- Used in the computer's regular operations, after loading the OS.	Used mostly in a computer's start-up process.
2- With RAM, writing data is a fast process.	Writing data to ROM is very slow.
3- RAM is a type of volatile memory, meaning the stored data is lost when powering off.	ROM is a type of non-volatile memory, meaning that the data will not be lost when power is removed.
4- A RAM chip can store quite a lot of data, up to 16 GB.	ROM chips usually store only a few megabytes of information, around 4 MB per chip.
5- There are two main types of RAM: dynamic (DRAM) and static (SRAM).	ROM types include EPROM, EEPROM, PROM and Mask ROM.
6- Example of RAM: RAM chips like 2GB, 4GB, 8GB etc of different companies like Corsair, Kingston etc.	Example of ROM: cartridge in video game consoles, computer BIOS.

#### Q6) difference btw embedded c and c?

- Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems.
- There are many popular programming languages like Assembly, BASIC, C++, Python etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability.

#### C Programming

- C language is a structure-oriented language, developed by Dennis Ritchie. It provides less memory access using the simple compiler and delivers the data efficiently according to machine instructions. They are applicable in wide ranges from embedded systems to supercomputers.

#### Embedded C

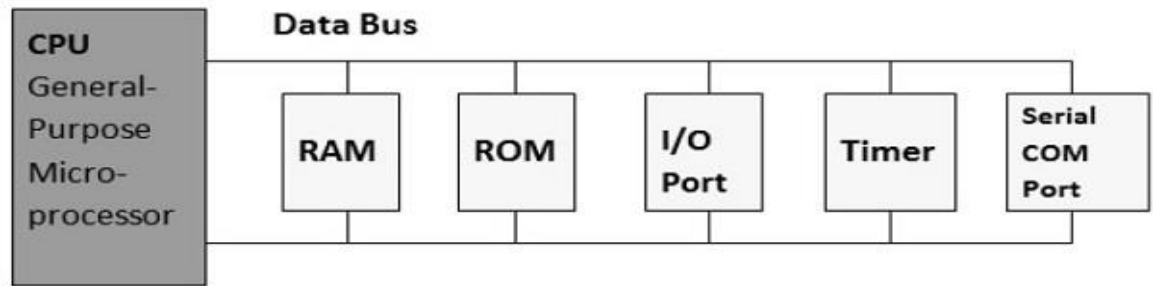
- Embedded C is an extension of the C language, which is used for developing an embedded system. The syntax is similar to C language (like the main function, functions declaration, data types declaration, loops, etc). The main difference between embedded C and standard C language are input-output addressing of hardware, fixed-point operations, and processing address spaces.

<b>C Language</b>	<b>Embedded C Language</b>
Generally, this language is used to develop desktop-based applications	Embedded C language is used to develop microcontroller-based applications.
C language is not an extension to any programming language, but a general-purpose programming language	Embedded C is an extension to the C programming language including different features such as addressing I/O, fixed-point arithmetic, multiple-memory addressing, etc.
It processes native development in nature	It processes cross development in nature
It is independent for hardware architecture	It depends on the hardware architecture of the microcontroller & other devices

•

The compilers of C language depends on the operating system	Embedded C compilers are OS independent
In C language, the standard compilers are used for executing a program	In embedded C language, specific compilers are used.
The popular compilers used in this language are GCC, Borland turbo C, Intel C++, etc	The popular compilers used in this language are Keil, BiPOM Electronics & green hill
The format of C language is free-format	Its format mainly depends on the kind of microprocessor used.
Optimization of this language is normal	Optimization of this language is a high level
It is very easy to modify & read	It is not easy to modify & read
Bug fixing is easy	Bug fixing of this language is complicated

Q7)architecture of block diagram of microprocessor and micro controller?



A SIMPLE BLOCK DIAGRAM OF A MICROPROCESSOR

### Microcontroller

